REMARKS

The Office Action dated October 17, 2005, has been reviewed carefully and the Application has been amended in a sincere effort to place it in condition for allowance.

Claims 1 through 22 are pending in the Application

Claims 1-14 were rejected.

Claim 15 - 22 were added to better claim the invention.

At paragraph 3 of the Office Action, the Examiner objected to the Abstract as not being in the proper format. The appropriate correction has been made to the Abstract.

At paragraph 4, the Examiner requested additional documentation. These publications are enclosed herewith in a Supplementary Information Disclosure Statement.

At paragraph 7 of the Office Action, the Examiner objected to the drawings, indicating that Fig. 2 should be designated by a legend, such as prior art. A replacement sheet is included herewith for approval of the Examiner.

At paragraph 8 of the Office Action claims 10-14 were rejected under 35 U.S.C.§ 101. Claim 10, the independent claim in this set, has been amended to recite a computer readable medium as required by the Examiner, and the dependent claims have also been amended in a similar manner. Claim 10-14 are now in the appropriate format and satisfies the requirement of 35 U.S.C.§ 101.

At paragraph 8 of the Office Action, the Examiner rejected claims 1-3 and 10-12 under 35 U.S.C.§ 102(b) as being anticipated by Farmani et al. "parameter estimation in water distribution networks using genetic algorithms" (Farmani).

Applicant's invention as claimed in representative claim 1, as amended, comprises in part:

> A method of automatically calibrating a water distribution model of a water distribution network, including the steps of:
>
> ***(A) selecting calibration parameters including link status and one or more of pipe roughness and junction demand;***
>
> (B) calibration parameters including one or more of pipe roughness, junction demand, and link status;
>
> (C) collecting field observed data including a pipe flow measurement and a junction pressure measurement for at least one point in the water distribution network, and including corresponding loading conditions and boundary conditions that existed in the network when said field observed data was collected;
>
> (D) generating a population of trial solutions that comprise a set of calibration results, using a genetic algorithm; and
>
> (E) running multiple hydraulic simulations of each trial solution to obtain a set of predictions of pipe flows and junction pressures at selected points in the network, corresponding to the different loading conditions and associated boundary conditions when the field observed data was collected.

Briefly, Applicant's invention runs a hydraulic simulation for a complete data set to represent the overall system conditions at any given time of day. One calibration run, which can be either manual or optimized, is a complete data set of 1) calibration parameter of selected roughness groups, demand groups and operable links; 2) selected field data sets that include calibration target data and boundary data; 3) selected type of goodness of fit criteria; 4) selected types of waiting functions; 5) selected genetic algorithm parameter; and 6) selected number of top solutions.

In sharp contrast, Farmani's method is based only upon demand loading conditions and does not consider systemic conditions. Thus, it misrepresents the overall conditions for the hydraulic simulation thus resulting in incorrect solutions for practical applications of automatic model calibration methods. Notably, Farmani's method does not include link status as one calibration parameter. Link status includes pipe operation status of open/closed, valve operation status of open/closed, and pipe operation of on/off. Link status is recited in amended claim 1. Support for this is found in the specification on page 10 at line 12. As noted, Applicant's invention allows an engineer to collect a complete set of data to represent the overall system conditions at any given time of day, and the link status is an important aspect of this data set, that is not taught by Farmani. Thus, Farmani is legally precluded from anticipating Claim 1 due to the absence from Farmani of the concept of link status.

It is thus respectfully submitted that independent claim 1, as amended, and the claims dependent therefrom are not anticipated by the Farmani reference.

Applicant's invention as claimed in independent claim 10, as amended, comprises in part:

A computer readable medium containing executable program instructions for automatically calibrating a water distribution model of a water distribution network that has links that include pipes and junctions, the executable program instructions comprising program instructions for:

(A) generating a graphic user interface by which the user may enter data concerning field observed measurements for the network, and may make other entries and selections;

(B) a calibration module formatted to produce calibration information for a water distribution model constructed from user-selected calibration parameters that include at least one of pipe roughness, junction demand information, including demand groups, and link status;

(C) a genetic algorithm module coupled to said calibration module and said user interface such that information about said calibration parameters, and user-entered field observed data, ***including selected field data sets that include calibration target data and boundary data, may be operated upon to produce a population of trial solutions, and said user interface further being configured to allow a user to select goodness-of-fit criteria, a weighting function, and or more genetic algorithm parameters and a number of top trial solutions; and***

(D) ***a hydraulic network simulation module communicating with said genetic algorithm module such that top solutions generated by said genetic algorithm module can be run by said hydraulic network simulation module and saved to be used to predict actual behavior of said network.***

With respect to independent claim 10, Applicant's system is distinguished from the Farmani method in that the integrated calibration method and system of the present invention allow the viewer to view top solutions saved at the end of the run as set forth in amended independent claim 10. Furthermore, boundary data is also incorporated in Applicant's system which is taught in the Farmani reference. In addition, several other types of items including goodness-of-fit criteria, weighting functions, genetic algorithm parameters and number of top solutions are not available for selection in Farmani. Furthermore, multiple calibration runs can be created and saved and reviewed by the user, which is not taught in the Farmani method.

With all of these features absent from Farmani, then Farmani cannot have anticipated Applicant's claim 10 and the claims dependent therefrom.

New claims have been recited to better claim the invention. For example Farmani does not permit the original roughness coefficient to be calibrated by multiplying it with a factor as recited in new claim 15.

Accordingly, it is respectfully submitted that claims 1-3 and 10-14 are allowable over the Farmani reference.

At paragraphs 16 of the Office Action, claims 4-9 and 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Farmani et al. in view of ECAC as defined in the Office Action. As for claim 4, Farmani's paper does not associate the loading condition with the given time of day as set forth above. Neither does ECAC. The description given by ECAC (page 8, paragraph 5) emphasizes the field observed data such as tank levels at a given time. The observed data, like tank levels, is completely a different concept from the loading condition which is the baseline water consumption throughout a system. A loading condition varies from time to time. The present invention allows users to specify the corresponding loading condition at a given time for each of the said corresponding full data sets that include calibration target and boundary condition data. This is similar to presenting a snapshot of the system dynamic conditions at a particular point in time. This is not taught or suggested by either Farmani or ECAC nor does the combination of the two references make such subject matter obvious.

As for claim 5, multiple loading conditions are also not given for particular times of day in either cited reference.

With respect to claim 6, Farmani does not mention boundary conditions as part of the calibration formulation. The ECAC does not recognize boundary conditions as part of model calibration data. Neither of the documents, alone or in combination, discloses the use of boundary conditions for model calibration or how to use it for calibration. The

present invention formulates a comprehensive approach of using boundary conditions data for model calibration.

With respect to claim 7, the present invention implements an interactive procedure for manual calibration in which the user can adjust model parameters for the selected calibration groups against a combination of selected full data sets. These features are not disclosed or taught by either reference alone or in combination.

With respect to claim 8, neither Farmani nor ECAC discloses the concept or method for sensitivity analysis of the calibrated model parameters. ECAC's description on page 2, last sentence, is about general calibration procedures, not sensitivity analysis of the calibrated solution.

With respect to claim 9, the present invention is distinguished from Farmani's method in that the present invention calibrates the model by adjusting a collection of parameters for groups of pipes, groups of nodes, and multiple operable links. This is not disclosed or taught by either reference.

With respect to claim 14, Farmani's description on page 431 and 432, does not represent a user interface in its description of the data requirements for a given method. Farmani's description of calibration data requirements and calibration parameters are in conflict with one another and thus the reference does not provide a clear suggestion or formulation for model calibration to those skilled in the art.

Applicant's invention provides an integrated calibration system that allows a user to enter information about alternative demand loadings, representing a demand for a wa-

ter supply at a given point in time, at a given location in the network. In addition, multiple field data sets for calibration can be provided and each data set contains calibration target data and boundary data in accordance with Applicant's invention. Neither Farmani nor ECAC discloses or teaches such features.

In paragraph 24 of the Office Action, claim 13 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Farmani in view of SXST. Neither Farmani nor SXST discloses the concept and method for storing calibration data, calibration run settings and calibration solutions in a database. Furthermore, claim 13 is a dependent claim which depends from an allowable independent claim and is therefore also in condition for allowance.

All of the independent claims have been amended herein, therefore all of the claims have been amended either directly or through dependency.

New claims 15-21 have been added herein to better claim the invention.

All of the Examiner's objections and rejections have been addressed herein and it is respectfully submitted that the Application is now in condition for allowance.

Please do not hesitate to contact the undersigned in order to advance the prosecution of this application in any respect.

Please charge any additional fee occasioned by this paper to our Deposit Account No. 03-1237.

Respectfully submitted,

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